



National Aeronautics and
Space Administration



Aeronautics

Low-Cost, Low-Power, Portable Mounting Platform for Auto-Tracking Antenna

Offers continuous rotation of nearly 60 pounds of multiple antennas in azimuth and vertical axis

Researchers at NASA's Armstrong Flight Research Center have designed an innovative antenna-mounting platform that addresses an unmet need in the unmanned aerial vehicle (UAV) market and could even be applied to some satellite and marine applications. This unique continuously rotating platform is small and lightweight enough that one person can carry it, yet its simple setup and configuration can accommodate nearly 60 pounds of antennas, transmitters, and receivers in any combination. Powered by 120 VAC, the platform can move all of the antennas simultaneously in continuous rotation in azimuth and vertical $\pm 180^\circ$, effectively tracking a line-of-sight object up to 20 miles away. Unlike other platforms currently available, the innovative, flexible design for smaller, low-power (< 10 W) transmission antennas uses less expensive motors, keeping the price tag below \$5,000. It could be used to track any line-of-sight object carrying multiple radio frequency (RF) sources.

BENEFITS

- ➔ **Portable:** Lightweight components and a small profile allow the platform to be carried by a single person.
- ➔ **Simple:** Its unique design eliminates the need for additional load-balancing hardware, simplifying setup.
- ➔ **Versatile:** Up to 58 pounds (26 kg) of multiple antennas from various manufacturers in any combination (i.e., Yagi-Uda, dish/parabolic, omnidirectional, patch/microstrip) under 10 W can be accommodated.
- ➔ **Low power:** Using a smaller motor that is faster than those used on other platforms requires less power to achieve continuous rotation.
- ➔ **Low cost:** The overall system is estimated to cost less than \$5,000.

technology solution



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THE TECHNOLOGY

NASA researchers originally developed this technology for use with research UAVs, which often involve multiple transmitters and receivers on the aircraft and on the ground. This equipment emits RF signals that include video, command and control, and signals to/from the UAV as well as the research data of interest. Therefore, multiple antennas must be pointed at a single UAV. However, a low-power, low-cost, portable multi-antenna platform for tracking UAVs did not exist. NASA researchers found a middle ground between the low-end systems that support only one antenna and the expensive, high-end systems designed for military use, and their design has applications beyond UAVs.

How It Works

This innovation is a platform with a horizontal bar for mounting up to 58 pounds of antenna equipment, motors and gears to implement rotation, and customized software to automatically track the target object (e.g., UAV). The horizontal bar allows antenna equipment to be very close to the axis of rotation, thus minimizing the moment of inertia for the elevation motor. The platform's unique design also uses fiber optic rotary joints and slip rings where appropriate, which are much less expensive than the RF rotary joints used in existing high-power tracking antenna systems. The platform requires only 120 VAC of power to provide continuous azimuth and vertical $\pm 180^\circ$ rotation of antenna equipment on a continuous basis, maintaining 20-mile line-of-sight tracking.

The auto-tracking system uses the target object's Global Positioning System (GPS) coordinates and the GPS coordinates of the antenna to maintain its line-of-sight monitoring. Its aiming position is updated at a frequency of 30 Hz. An open software interface allows the system to be used with any set of antennas, transmitters, and receivers.

Why It Is Better

With its horizontal bar configuration, this innovation provides a simple mechanism to attach multiple antennas to an auto-tracking platform. Furthermore, keeping the antenna equipment close to the axis of rotation eliminates the need for load-balancing weights. This frees up more space/weight for antenna equipment while enabling the use of smaller, lower power, less costly motors than with existing systems.

This portable system provides a lightweight and inexpensive means to track a UAV or other object with multiple types of antenna equipment—Yagi-Uda, dish/parabolic, omnidirectional, and/or patch/microstrip in varying combinations. The ability to track line-of-sight objects with multiple RF sources makes this technology ideal for use with small UAVs for academic and government research. It could also be used for communicating with marine ships in line of sight, tracking satellites in non-geosynchronous orbit, and other applications.

APPLICATIONS

The technology has several potential applications:

- ➔ Law enforcement
- ➔ Surveillance
- ➔ Atmospheric and Earth science research
- ➔ Agriculture (e.g., crop spraying)
- ➔ Monitoring/Protecting animal species
- ➔ Marine communication
- ➔ Tracking satellites that transmit multiple frequencies from a non-geosynchronous orbit
- ➔ University research aircraft
- ➔ Weather balloons

PUBLICATIONS

Patent Pending

Auto-Tracking Antenna Design: UAS in the NAS Project, poster presentation, prepared May 2015



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